

# DOE Sci. & Tec. Review

**Aihong Tang**

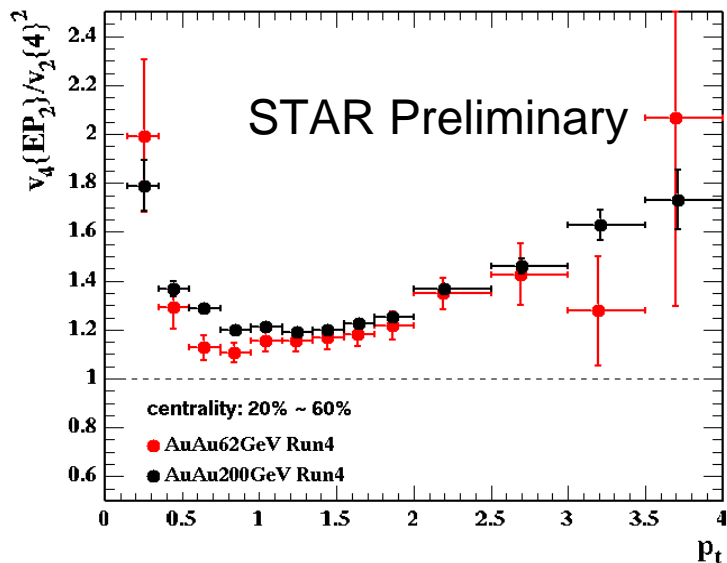
**Assistant Scientist**  
**Co-convenor of STAR event-by-event physics working group**

# Objectives

---

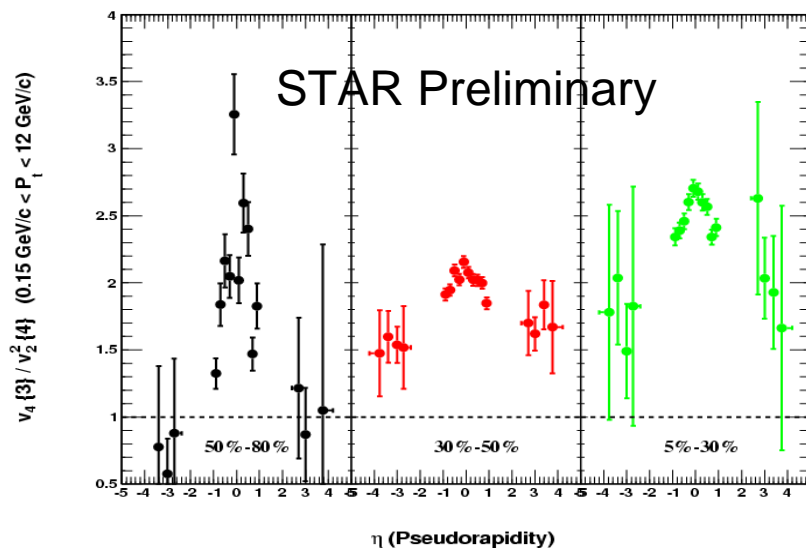
- Anisotropic flow studies - Understand the bulk properties of the matter created at RHIC
  - How perfect ? ( $v_4/v_2^2$  ratio) (BNL & NIKHEF)
  - Reaction dynamics at early time (direct photon flow) (BNL & YALE)
  - Phase transition signal via directed flow ? (BNL, UCLA, LBL, WAYNE and KENT)
  - Understand initial conditions via event by event  $v_2$  fluctuations (BNL, UCLA, WAYNE)
- Strangelet Search at RHIC (BNL, Space Sci. Lab UC Berkeley, WAYNE, KENT)

# $v_4/v_2^2$ ratio : Understanding “how perfect” is the matter

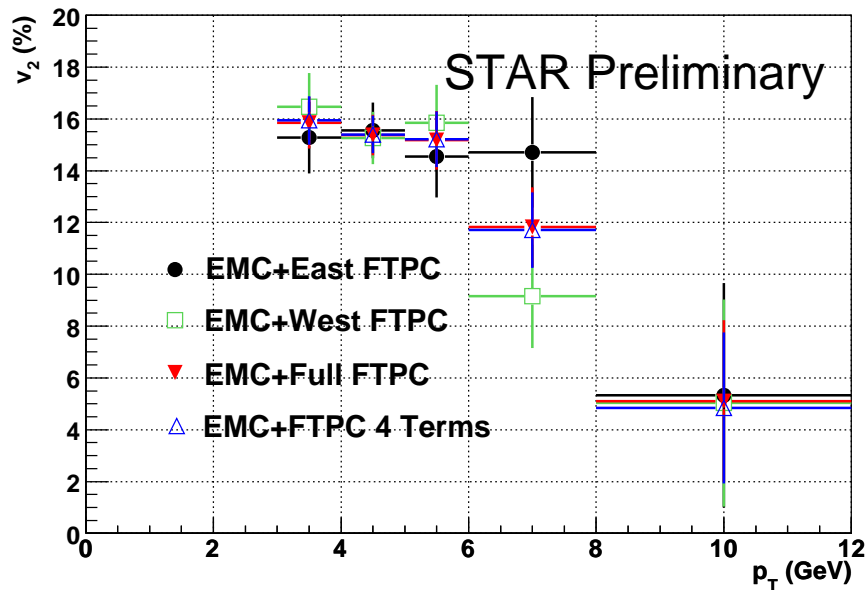


- $v_4/v_2^2$  is sensitive to degree of thermalization
- Explore the property of the matter by comparing the ratio from the data to that from Hydro prediction

- Use both event plane method and higher order cumulant method to study the ratio. The latter can be done by STAR only so far.
- A CPU intensive project, thanks to STAR computing team to make this job done more efficiently.



Joint effort with Y. Bai (NIKHEF) and R. Snellings (NIKHEF)

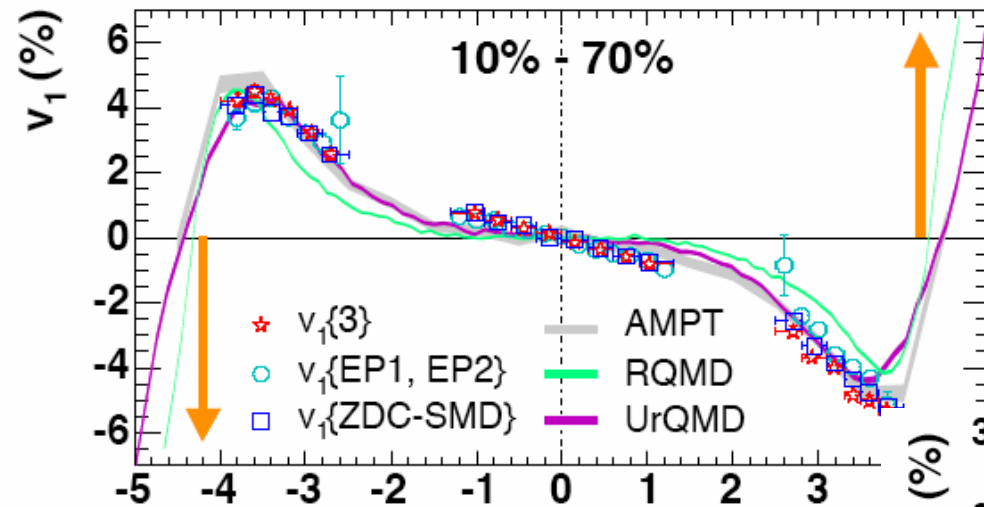


- Different reaction dynamics (jet energy loss, positive space-momentum correlation etc.) predict different direct photon  $v_2$  behaviors at mid- $p_T$  range.
- Study directed photon  $v_2$  involving QGP would provide a stringent test of the reaction dynamics at early time

- Not an easy job because large nonflow effect at high  $p_T$ , as well as other systematics from STAR BEMC
- Use a few different methods (scalar product, cumulant, event plane from FTFC etc.) to cross check inclusive photon  $v_2$
- Inclusive photon  $v_2$  measured up to 10 GeV/c in  $p_T$

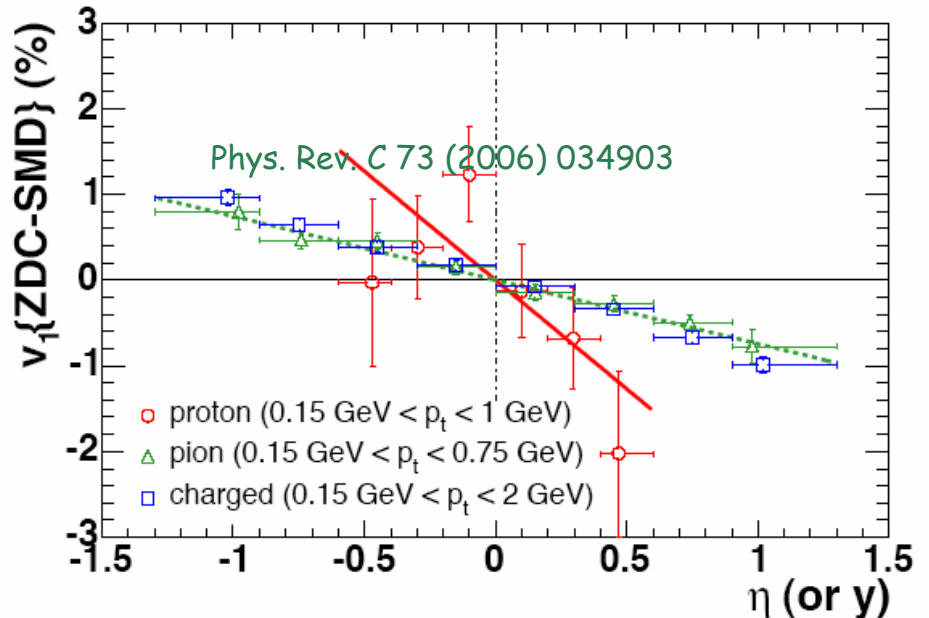
Joint effort with G. Lin (Yale)

## Directed flow - Understand the phase transition



- “Anti-flow” in near central collisions, a signature of first order phase transition, will cause protons at mid-rapidity flow in the direction of pion flow

- No obvious wiggle structure seen for charged particles.
- Charged particle directed flow is in the direction opposite to that of fragmentation neutrons



Joint effort with G. Wang (UCLA), D. Kean (Kent), M. Oldenburg (LBL), S. Voloshin (Wayne) and Z. Xu (BNL)

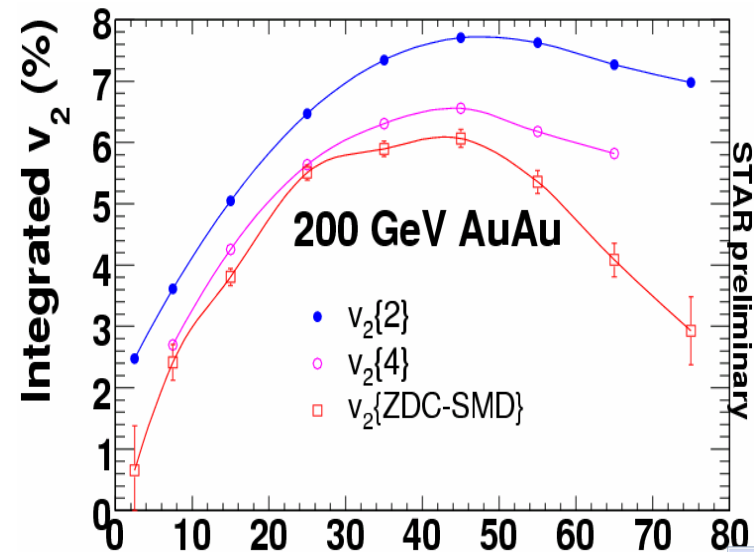
# Studying flow fluctuation by measuring Event by Event $v_2$



$$\frac{\langle Q_e Q_w u_2^* \rangle}{\langle Q_e Q_w \rangle} = \frac{\langle M_e M_w \rangle \langle v_{1,e} v_{1,w} \rangle v_2}{\langle M_e M_w \rangle \langle v_{1,e} v_{1,w} \rangle} = v_2$$

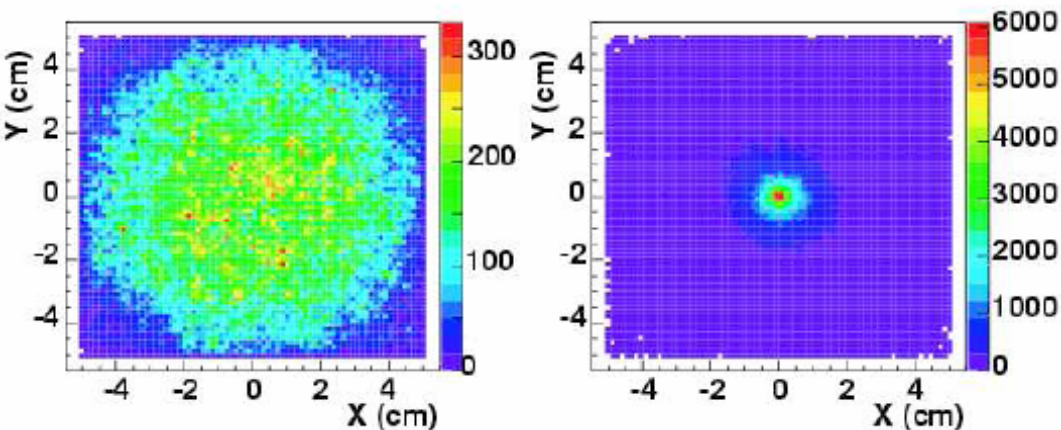
- Non-flow suppressed,
- fluctuation contributed minimum
- the least biased  $v_2$  measurement

- Flow fluctuation may help us understanding the initial condition
- Not well explored until recently
- Using 1st order event plane from ZDC-SMD, for the first time, we can measure event by event  $v_2$  - we can study  $v_2$  fluctuation



Joint effort with G. Wang (UCLA), P. Sorensen (BNL), and S. Voloshin (Wayne)

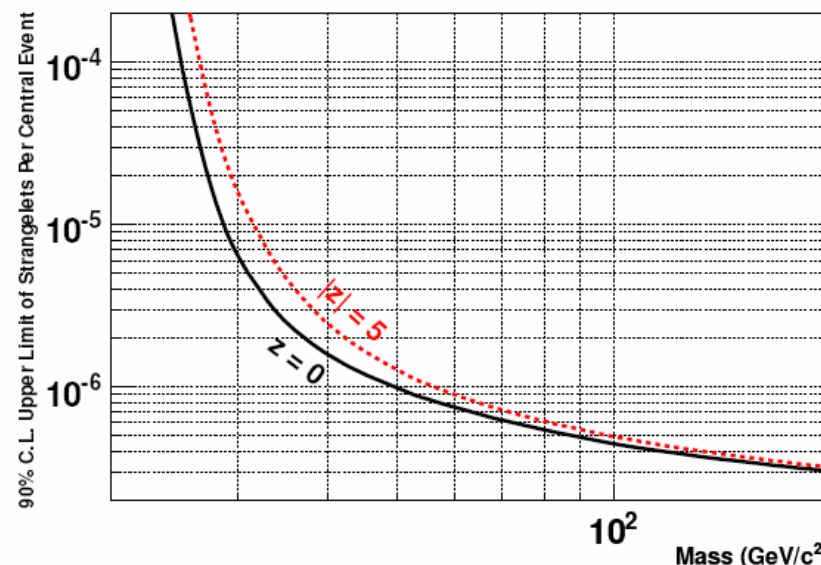
# Strangelet Search at RHIC



- Pomeron breaking could produce strangelet at forward rapidity
- Can be detected by STAR - ZDC SMD

- First search for strangelet at RHIC, focused on forward rapidity.
- Upper limits is set.

Nucl-ex/0511047



Joint effort with Z. Xu (BNL), H. Crawford (Space Sci. Lab. UC Berkeley), D. Keane (Kent), B.Szeliga (Wayne), S. Voloshin(Wayne), G. Wang(Kent)

- Anisotropic flow studies will help us understand in detail the property of the matter that RHIC has recreated. STAR/BNL group has advanced technologies for these studies, we keep implementing new ideas and continue to hold a strong position in this area in Heavy Ion Community.
- We have made the first attempt to search for strangelets at RHIC.